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SYSTEMATIC

MINERAL RECORD,

WITH A

SYNOPSIS OF TERMS AND CHEMICAL REACTIONS

USED IN DESCRIBING MINERALS.

PREPARED FOR

INSTRUCTORS AND STUDENTS IN MINERALOGY,

BY

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ADAPTED TO ANY MINERALOGY.

A. S. BARNES & CO., Publishers,
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INTRODUCTION.

THERE is no study that can be made more interesting and useful than that of mineralogy, and in no branch of science is the use of a text-book, alone, so inadequate as in this one. To study minerals, the student must have the specimens not only before him, but actually in his hands, that he may feel, examine, and test for himself, and it is to aid him in this original investigation that these Tables have been prepared.

The established value of the various Plant Records in the study of Botany, first suggested to the writer the use of a printed Mineral Analysis, which he has used in his classes for four years, and with such success as, seemingly, to justify placing it before a larger public than it has hitherto served. The Tables presented in this little work are a slight amplification of what he believes to have been the first Mineral Analysis ever published.

It is hoped that this schedule will prove useful in training the student to habits of thorough observation and correct methods of reasoning, while, used in connection with some good work on Determinative Mineralogy, it will become the means, not only of gaining familiarity with a very practical department of knowledge, but of providing him with valuable mental drill.

The following is suggested as an excellent method of using the Tables:—Give each student a mineral to take home for study; let him write out a careful description of the different physical and optical properties, after which he may take it to the laboratory to determine its chemical characters.

This having been done, the mineral may be analyzed from some Determinative Mineralogy and its name ascertained. This work should be followed by lectures from the instructor upon the varieties, localities, etc., of the mineral, differences between it and minerals resembling but not allied to it, the uses of the mineral in the arts and in nature, and its origin. A summary of the instructor's lecture, written on the back of

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the schedule containing the description of any given specimen, completes the student's work, which, if carefully performed, will give him a better acquaintance with the subject than he can obtain in any other way.

In preparing the Tables, the writer has consulted freely all books on mineralogy at his command, especially Prof. Brushes' Determinative Mineralogy, Prof. Dana's Manuals and the works of Collins and Bauerman. He will be glad of any suggestions or corrections that may add to the usefulness of this work.

SPRINGFIELD, Mo., Jan. 1884.

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EXPLANATORY TEXT TO ACCOMPANY THE SCHEDULES.

A MINERAL is defined as any natural, homogeneous, inorganic body found free in nature. Rocks are aggregations of different minerals, or masses of one kind of mineral. For example, granite is an aggregation of three mineral bodies, mica, quartz, and feldspar; while calcite, a homogeneous, inorganic body, is ordinarily called a mineral, but when occurring in large masses it is called a rock. Most minerals are solid bodies, as quartz, calcite, etc.; a few are liquid, as bitumen, petroleum, asphaltum, etc., while several are gases, as air and sulphuretted hydrogen.

All minerals possess certain peculiar properties which are, for convenience, arranged under such heads as the following:

I.—Physical Properties.
II.—Optical.*
III.—Form.*
IV.—Chemical Characters.

The student should observe the above characteristics in all mineral bodies, and the following tables are so arranged that a carefully tabulated examination, in connection with some good work on Determinative Mineralogy, will give him a more perfect knowledge of a certain mineral than he would obtain in any other way.

The student will notice that a general knowledge of chemistry and physics is necessary to a perfect understanding of these tables. A small blow-pipe laboratory can be arranged with trifling expense, a few dollars and a little ingenuity sufficing to make a very respectable outfit, although a greater expenditure will, of course, result in a more satisfactory equipment. The writer performed the most of his early work in a home-made laboratory that cost less than four dollars. Lists of apparatus and chemicals necessary for blow-pipe analysis will be given elsewhere, also hints for the construction of some of the more simple parts of the laboratory outfit.

* Separated from Physical characters for convenience only.

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I.—PHYSICAL PROPERTIES.

Under physcical properties, the following characteristics are to be noticed:

1. Touch.	4. Hardness.	7. Cleavage.
2. Specific Gravity.	5. Fracture.	8. Magnetism.
3. Structure.	6. Tenacity.	9. Electricity.

1. **Touch,** the peculiar feel that some minerals possess. The touch may be

(a.) *Unctuous,* having the greasy feel characteristic of soapstone.
(b.) *Harsh,* the scratchy feel of actinolite.
(c.) *Meagre,* dry and rough to the touch, as chalk and magnesia.
(d.) *Soft,* as asbestos, or mountain leather.
(e.) *Smooth,* as the plane of a quartz crystal.

2. **Specific Gravity.** The specific gravity of a body is its weight as compared with any other body that is taken as a standard. Hydrogen gas, the lightest substance known, is, under specified conditions of temperature and pressure, usually taken as the standard for gases, and water, at its maximum density, as that for solids. Specific gravity is said to be

(a.) *Highest,* when more than fifteen times as heavy as water. Ex. Gold, sp. gr. 19.
(b.) *Very high,* when between ten and fifteen. Ex. Silver, 10.
(c.) *High,* when between five and ten. Ex. Galena, 7.
(d.) *Medium,* when between three and five. Ex. Barite, 4.5.
(e.) *Low,* when between one and three. Ex. Quartz, 2.5.

Specific gravity is readily found by obtaining first the weight of the mineral in air, then its weight in water, after which, subtract the second weight from the first to find the loss by immersion; divide the first weight by this difference, and the quotient is the result sought. By a little practice with minerals of known specific gravity, the student will soon be able to judge quite accurately of the specific gravity of any given specimen. The table given above will be found a convenient one for common use.

3. **Structure** is the next point to be noticed, and the following terms are usually employed to distinguish the various kinds of structure.

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(a.) *Massive,* when in rock-masses, without regular form. Ex. Limestone.
(b.) *Tabular,* in thick plates or layers. Ex. Feldspar.
(c.) *Lamellar,* in rather thin plates. Ex. Selenite.
(d.) *Micaceous,* in very thin plates or scales. Ex. Mica.
(e.) *Foliated,* in thin, irregular plates, schist-like. Ex. Talc.
(f.) *Plumose,* scales arranged in a somewhat feathery form. Ex. Plumose mica.
(g.) *Capillary,* fine, hair-like crystals embedded in the same or another mineral. Ex. Rutile penetrating quartz.
(h.) *Fibrous,* in fine, straight or curved fibres. Ex. Gypsum.
(i.) *Stellate,* fibres radiating from centers in every direction. Ex. Stibnite.
(j.) *Radiate,* the fibres diverging less regularly from a common center than the last. Ex. Pyrolusite.
(k.) *Reticulate,* the fibres so crossed as to form meshes. Ex. Tremolite.
(l.) *Bladed,* composed of long narrow plates, like the blade of a knife. Ex. Actinolite.
(m.) *Septate,* divided into compartments by intersecting plates. Ex. Some varieties of tabular quartz.
(n.) *Banded,* the alternating layers giving the mineral a striped appearance. Ex. Agate.
(o.) *Pisolitic,* agglutinated, pea-shaped masses. Ex. Pisolite.
(p.) *Oölitic,* agglutinated grains, resembling the roe of fish. Ex. Oölitic limestone.
(q.) *Mossy,* resembling moss in appearance. Ex. Native silver.
(r.) *Coralloidal,* when several pointed branches proceed from a common stem. Ex. Aragonite.
(s.) *Nodular,* the surface having irregular protuberances.
(t.) *Acicular,* sharp and fine-pointed, like a needle. Ex. Pectolite.
(u.) *Drusy,* the surface covered with minute crystals. Ex. Drusy quartz.

4. **Hardness.** The degree of hardness in all solid minerals is arranged, by Mr. Chapman, upon a scale of ten, the softest ranking as one, and the hardest substance known as ten. The following is the scale used by most mineralogists:

1. *Talc,* can be scratched with the finger-nail.
2. *Rock-salt,* a little too hard to be scratched with the nail; will not scratch a copper cent.

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3. *Calcite,* nearly equal in hardness to a copper cent; they will scratch each other.
4. *Fluorite.* a copper cent will not scratch it.
5. *Apatite,* will easily scratch glass, leaving its powder upon it; easily scratched by the knife.
6. *Feldspar,* easily scratches glass, and is, with difficulty, scratched by the knife.
7. *Quartz,* cannot be scratched by the knife.
8. *Topaz,* will scratch quartz.
9. *Corundum,* still harder.
10. *Diamond,* can be scratched by nothing.

5. **Fracture.** This refers to any broken surface that is not a cleavage plane (see cleavage plane below). As regards *form*, fracture is

(a.) *Even,* when the surface is free from irregularities.
(b.) *Uneven,* when there are depressions and elevations over the surface.
(c.) *Conchoidal,* having curved depressions, as in chalcedony.

As to the *condition* of the broken surface, it is

(a.) *Smooth.*
(b.) *Splintery,* breaking into splinters. Ex. Serpentine.
(c.) *Hackly,* rough, with sharp points. Ex. Copper.
(d.) *Earthy.* Ex. Clay.

6. **Tenacity.** As regards tenacity, minerals are

(a.) *Brittle,* when the particles fly off readily, if the specimen is cut or broken. Ex. Tourmaline.
(b.) *Friable,* when particles can be easily rubbed off with the fingers. Ex. Granular quartz.
(c.) *Tough,* when broken with difficulty. Ex. Hornblende.
(d.) *Sectile,* readily cut with a knife, but crumbling if pounded. Ex. Argentite.
(e.) *Malleable,* readily cut, and flattening in layers when pounded. Ex. Copper.
(f.) *Flexible,* easily bent, but will not fly back to its original position. Ex. Selenite.
(g.) *Elastic,* if bent, will fly back to its original position. Ex. Mica.
(h.) *Viscous,* having the nature of asphaltum or mineral pitch.

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7. **Cleavage.** This is the property which some minerals possess of breaking readily into smooth surfaces called cleavage planes. We study first the *degree*, and second, the *kind* of cleavage. As to degree, it is

(a.) *Eminent*, very perfect, as in mica.
(b.) *Perfect*, as in fluor spar.
(c.) *Less perfect*, as in feldspar.
(d.) *Imperfect*, as in garnet.
(e.) *Very imperfect*, where the faintest evidence of cleavage is seen.
(f.) *Absent*, when there is none.

As to kind, cleavable minerals, particularly crystallized specimens, break into regular forms characteristic of the systems of crystallization to which they belong. For example, galena, pyrites, and salt break into cubes; sal ammoniac and fluor spar into octahedrons; zinc blende into rhombic dodecahedrons; calcite into rhombohedrons.

It will be noticed that minerals which easily decrepitate before the blow-pipe, break into regular cleavage planes.

8. **Magnetism.** Most minerals that contain iron to any great extent are magnetic either before or after fusion – generally the latter. For example, magnetic iron ore, before fusion, and many of the iron ores and the metallic sulphides containing iron, are magnetic after heating before the blow-pipe.

9. **Electricity.** Most minerals are affected more or less electrically by heating or friction, and may then possess the property of attracting light substances.

Minerals are thermo-electric or frictio-electric. Of the former, topaz, tourmaline and electric calamine are good examples, the electrical property being, in all but topaz, retained for only a short time. Of the frictio-electric minerals, zinc blende may be mentioned as an example. Pressure will also, in many cases, develop electricity, as in calcite, fluor spar and quartz.

II.—OPTICAL CHARACTERS.

The optical characters of minerals refer to the action of light upon the specimen; for convenience of description they are separated from the Physical characteristics, and are as follows:

1. COLOR.
2. LUSTRE.
3. STREAK.
4. DIAPHANEITY.
5. IRIDESCENCE.
6. PHOSPHORESCENCE.

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1. **Color** is not an inherent property of matter, but depends upon the power a body has of absorbing certain rays of the spectrum and reflecting certain others. When, for example, a body absorbs all the rays but yellow, and reflects those to the eye, we call the object yellow. A white object reflects all the rays of the spectrum, absorbing none; a black object absorbs them all, reflecting none. White and black, though not colors, strictly speaking, are here treated as such for convenience.

As regards color, minerals are divided into those with metallic and those with non-metallic colors.

The former are the colors of the common metals, viz., copper-red, bronze-red, bronze-yellow, brass-yellow, golden-yellow, tin-white, lead-gray, steel-gray and iron-black.

The non-metallic colors are the various shades of black, white, gray, blue, green, yellow, red and brown.

Of the blacks, we may have velvet-black, grayish-black, pitch-black, reddish-black, raven-black, and bluish-black.

Of the whites, snow-white, yellowish-white, reddish-white, greenish-white, milk-white, and grayish-white.

Of the grays, ash-gray, bluish-gray, greenish-gray, yellowish-gray, reddish-gray, smoke-gray, blackish-gray.

Of the blues, Prussian-blue, blackish-blue, azure, violet, lavender, indigo-blue, and sky-blue.

Of the greens, emerald-green, grass-green, verdigris, leek-green, apple-green, blackish-green, olive-green, and asparagus-green.

Of the yellows, lemon-yellow sulphur-yellow, straw-yellow, wax-yellow, honey-yellow, ochre-yellow, orange-yellow.

Of the reds, carmine, aurora, or fire-red, brick-red, scarlet, blood-red, flesh-red, cochineal-red, rose-red, crimson, peach-blossom-red, cherry-red, brownish-red.

Of the browns, chestnut-browns, clove-brown, hair-brown, yellowish-brown, wood-brown or umber, liver-brown, blackish-brown.*

The intensity of each of these shades should also be noticed, as dark or deep, light or pale. Color is of slight value in the determination of minerals, as it is such a variable property; the same species may run through a great variety of shades. Ex. Quartz.

2. **Lustre.** This is due to the dispersion and reflection of the rays of light upon the surface of a mineral. In defining this property, the student should notice

* From Bauerman's Mineralogy.

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two points: first, the *kind* of lustre, and second, the *degree* of its intensity. As to *kind*, lustre is

(a.) *Silky*, like silk; the lustre of some translucent fibrous minerals. Ex. Gypsum.

(b.) *Fatty or greasy*, the surface appearing as though freshly oiled. Ex. Serpentine.

(c.) *Opalescent*, reflecting a milky or pearly light from the interior. Ex. Opal.

(d.) *Waxy*, like the surface of wax. Ex. Talc.

(e.) *Nacreous, or pearly*, resembling mother-of-pearl; best seen on the cleavage planes of some minerals. Ex. Selenite.

(f.) *Resinous*, like resin. Ex. Zinc blende.

(g.) *Vitreous*, glass-like. Ex. Calcite.

(h.) *Adamantine*, as the diamond.

(i.) *Metallic*, the brilliant lustre characteristic of polished metals. Ex. Galena.

The term *sub-* may be prefixed to any of the above, indicating a low degree of lustre. As to *intensity*, we have the terms

(a.) *Dull*, when there is no lustre. Ex. Kaolin.

(b.) *Glimmering*, when the reflection of light is very faint. Ex. Flint.

(c.) *Glistening*, when the surface reflects light, but no image is formed. Ex. Talc.

(d.) *Shining*, when objects are faintly reflected from the surface. Ex. Dolomite.

(e.) *Brilliant*, when the image is pretty well defined.

(f.) *Splendent*, when the light reflects a clearly defined image. Ex. Diamond.

3. **Streak.** Besides the color of a mineral, the color of a scratch upon its surface should be noticed, also the powder rubbed off with the flat blade of a knife on white paper, or scratched upon a piece of white unglazed porcelain.

In opaque minerals the streak is generally darker than the mineral, but in the transparent minerals it is more frequently lighter.

5. **Diaphaneity** or transparency, is the quality of transmitting light, which is possessed in greater or less degree by most minerals. Minerals are said to be

(a.) *Transparent*, when objects are clearly seen through them. Ex. Iceland spar.

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(b.) *Sub-transparent,* when the image is imperfectly seen. Ex. Selenite.
(c.) *Translucent,* when light is transmitted, but no image seen. Ex. Opal.
(d.) *Subtranslucent,* when only the edges transmit light. Ex. Flint.
(e.) *Opaque,* when no light is transmitted. Ex. Magnetite.

5. **Iridescence** is the play of colors seen upon some minerals when viewed under oblique rays of light. It is seen in the rainbow-rings between the plates of mica, and in the peacock color on the surface of Elba iron ore, some of the feldspars, copper ores, etc.

6. **Phosphorescence** is the property of giving off light in the dark, and it is possessed by a few minerals. It is excited either by friction, heating, exposure to sunlight or an electric discharge. Two pieces of quartz crystal or loaf sugar rubbed together exhibit phosphorescence by friction, while zinc blende, and particularly the diamond, after exposure to sunlight, exhibit this property. Heating is the best means of obtaining this phenomenon.

III.—FORM.

This refers to the condition of the minerals; it may be

1. CRYSTALLIZED. 2. CRYSTALLINE. 3. IMITATIVE. 4. AMORPHOUS.

1. **Crystallized** minerals are solid geometrical bodies, bounded by plane surfaces; they are represented by an indefinite number of forms and modifications which have been reduced by the mineralogist, to six fundamental systems.

In these condensed notes, only the salient characteristics of each system will be given. They are

(a.) *Isometric.* The three axes of the crystals under this form are equal, and all cross each other at right-angles. Ex. Cube, octahedron, and dodecahedron.
(b.) *Dimetric.* The upright axis is unequal to the other two, and all cross at right-angles. Ex. Square prism and square octahedron.
(c.) *Trimetric.* The three axes are unequal, but cross at right-angles. Ex. Right rhombic prism, rhombic octahedron.
(d.) *Monoclinic.* All three axes are unequal, the lateral axes being at right-angles to each other, but the vertical axis inclined to the other two. Ex. Right rhombic prism, and oblique rhombic prism.
(e.) *Triclinic.* The three axes are unequal and oblique to each other. Ex. Oblique rhomboidal prism.

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(f.) *Hexagonal,* or Rhombohedral system. There are four axes, three lying in one plane, the angle of intersection being 60°, and the fourth crossing the other three at right-angles. The fourth axis may be longer or shorter than the others. Ex. Hexagonal prism, terminated by pyramids, and the rhombohedron.

If the teacher has no set of geometrical blocks with which to illustrate these forms, it will be excellent practice to require the student to cut them from raw potatoes or chalk, when he can teach them also how the secondary forms of crystallization are derived from the fundamental.

2. **Crystalline,** appearing as though composed of minute crystals closely compacted, or evidently an irregular fragment of a large crystal.

3. **Imitative,** assuming the form of some familiar object in nature. Of the imitative forms, we find the following varieties:

(a.) *Stalactitic,* the peculiar pendent form of a few minerals deposited from solution, particularly in caves. The term is not restricted to stalactites proper, but is applied to all resembling them in general characters.

(b.) *Reniform,* kidney or bean shaped, as occasionally seen in nodular iron pyrites, or kidney iron ore.

(c.) *Mammillary,* having rounded prominences half buried in the matrix, as in some forms of malachite.

(d.) *Botryoidal,* the rounded prominences so far raised from the surface as to resemble a bunch of grapes. Ex. Chalcedony and limonite occasionally.

(e.) *Globular,* portions of the mineral being massed in oval or globular masses, as in wavellite.

(f.) *Amygdaloidal* or concretionary, the matrix enclosing numerous globular or almond-shaped masses of the mineral.

(g.) *Geodes,* rounded, hollow nodules, usually lined with crystals.

(h.) *Dendritic,* exhibiting moss-like markings, as those made by black oxide of maganese.

(i.) *Pseudomorphic,* imitating the crystallized form of another mineral. Ex. Quartz is occasionally found in the cubical form of fluor spar, the fluor being replaced by the quartz by a process of substitution.

Imitation forms may be found in either crystallized, crystalline or amorphous conditions.

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4. **Amorphous.** Without any definite form and exhibiting neither external nor internal signs of crystallization.

IV.—CHEMICAL CHARACTERS.

In what follows, the writer has referred largely to Professor Brushes' admirable work on Determinative Mineralogy. In order to use the subjoined tables, the student is supposed to have a general knowledge of chemistry and access to some determinative mineralogy. The object of the tables being the development of the student's powers of observation, the reason for the repetition of several points in the arrangement of the schedule is evident. As every examination leads the student to observe more and more closely, points that may be overlooked in one place will be seen and recognized in another, thereby making the examination of the specimen complete. The teacher may, if he desire, omit one or more heads when the time is limited or the specimen in hand renders the repetition unnecessary, as in the case of IV., D, 3, in the tables. The chemical characters of minerals may be studied under the following heads:

A. Odor.
B. Taste.
C. Solubility.
D. Thermo-Chemical Examination.
1. B.B. Pt. forceps.
2. B.B. in closed glass tube.
3. B.B. in open glass tube.
4. B.B. on charcoal (*per se*).
5. B.B. with platinum wire and fluxes.
6. Sulphur test.
7. Cobalt nitrate test.

E. Composition.

A. **Odor.** Many minerals, particularly those containing magnesium and aluminum, give off an earthy smell. Some give forth odor when rubbed or moistened, others only when heated. The various kinds of odor are as follows:

(a.) *Argillaceous*, the clayey odor given off by minerals that contain magnesium or aluminum, as serpentine when breathed upon.

(b.) *Fetid.* When some minerals are rubbed or broken the odor of sulphuretted hydrogen, or that of rotten eggs is given off, as in some species of quartz and limestone.

(c.) *Alliaceous*, the odor of garlic. Arsenical ores, when rubbed or heated, yield this characteristic odor.

(d.) *Decaying* horseradish odor, given off by ores of selenium.

(e.) *Sulphurous*, the familiar odor of a burning sulphur match; obtained by heating minerals containing sulphur.

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B. **Taste.** This is a good test in all minerals soluble in water. The following are the kinds of taste noticed by mineralogists:

(a.) *Saline*, that of salt.
(b.) *Alkaline*, that of soda.
(c.) *Cooling*, that of nitre.
(d.) *Astringent*, that of vitriols.
(e.) *Sweetish astringent*, that of alum.
(f.) *Bitter*, that of Epsom salts.
(g.) *Sour*, an acid taste.

C. **Solubility.** If a mineral is soluble, the student should first notice whether it is soluble, (1) *In cold or hot water*, or, (2) *In hydrochloric acid*, and the degree of solubility in either. The following scale for testing with hydrochloric acid, the writer has adopted for use in his classes:

(1.) *Highly soluble*, with effervescence in cold acid.
(2.) *Slightly soluble* in cold acid, readily so in hot.
(3.) *Quietly soluble.*
(4.) *Gelatinizes.*
(5.) *Partially soluble.*
(6.) *Insoluble* in hot or cold acid.

The student should also notice and test for any gas that may be given off during solution. The following is a list of the most common, with the test for each:

CO_2, Carbonic anhydride, puts out a lighted taper, inserted in the tube; colorless. It renders turbid a drop of lime-water held suspended by a glass rod over the tube, thereby indicating a carbonate.

SO_2, Sulphurous anhydride, has the odor of sulphur; colorless. Gives acid reaction with moistened litmus paper, indicating a sulphide or sulphate.

H_2S, Sulphuretted hydrogen, has the odor of rotten eggs, indicating a hydrous sulphide.

NH_3, Ammonia gas; colorless. The tests are the familiar odor of ammonia, or a glass rod dipped in HCl and held over the test tube giving off white fumes of ammonium chloride, NH_4Cl.

Cl, Chlorine, a yellowish green gas with a suffocating odor. Dangerous to inhale.

O, Oxygen, colorless; a splinter with a spark, inserted in the tube, glows and burns brightly.

Fl, Fluorine, colorless; it is highly corrosive and will etch glass. Dangerous to inhale.

NO_2 Nitric peroxide, red fumes; has an acid reaction indicating a nitrate or nitride.

D. **Thermo-Chemical Examination.** The examination of a mineral with regard to the effect produced upon it by the application of heat, may be considered under several heads, the first of which is:

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1. Before the blow-pipe with platinum forceps, using a very small fragment of the mineral, called the *assay*. The student should note

(a.) *The degree of fusibility.* This is of the greatest importance in blow-pipe examination, and the following general scale of fusibility has been adopted by most mineralogists:

(1.) Antimony-glance and cryolite fuse readily in moderate sized splinters in the flame of an alcohol lamp.

(2.) Stilbite can be fused in small splinters in the the flame of the lamp.

(3.) Almandine garnet, moderate sized splinters fuse easily in blow-pipe flame.

(4.) Actinolite, a thin splinter fuses in O.F., B.B.

(5.) Feldspar, fuses with considerable difficulty B.B.

(6.) Bronzite, only the thinnest edges rounded B.B.

(7.) Infusible B.B.

The assay should always be examined in the O.F., B.B. with the platinum forceps, except in case of metals, when it is better to use charcoal. Notice next

(b.) *The color-flame.* This furnishes a ready means of detecting certain elements either alone or in combination. If the flame is

Yellow, the mineral may contain soda, or its salts.

Violet, the mineral may contain potash and most of its salts.

Red, the mineral may contain lithia, strontia or lime.

Blue, the mineral may contain copper chloride, sulphur, lead or arsenic.

Green, the mineral may contain copper, barium or the phosphates of various salts.

Greenish-blue, the mineral may contain antimony.

Some of these tests are facilitated by heating the assay to redness, applying hydrochloric acid and then renewing the heat. This is particularly true of the sulphides of some of the above elements, as the hydrochloric acid converts them into chlorides which are more volatile before the blow-pipe. Borates and phosphates should be treated as above, using sulphuric instead of hydrochloric acid.

(c.) *The volatility of the assay,* which is best found by placing a fragment in the platinum forceps, or on charcoal before the blow-pipe. In using the former, with metals, care should be taken that the heat is not so great as to cause the metal to form an alloy with the platinum of the forceps. Examination in the opened and closed glass tubes is also a valuable test for volatility. Some minerals are wholly volatile, while others are slightly so.

(d.) *Exfoliation.* If the mineral swells upon heating, as in the case of borax, it is said to exfoliate. Ex. Vermiculite.

(e.) *Intumescence,* a spurting out of the mass as it fuses. Ex. Scapolite.

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2. Examination in the closed tube. The tube, or matrass, as it is sometimes called, should be perfectly dry and clean. Heat the assay that is placed in the bottom, and note carefully the following characteristics:

(a.) Minerals containing water of crystallization give it off when heated, and the steam collects in the colder portion of the tube near its mouth. If this water is present, use litmus paper to discover whether it is acid or alkaline. If the mineral contains water, it said to be *hydrous;* if not, it is *anhydrous.*

(b.) If the assay snaps or flies to pieces, it is said to decrepitate.

(c.) Some minerals give off an intense light, and are then said to be glowing.

(d.) Change of color is characteristic of some minerals, and should be closely noticed. Certain salts of the elements given below show the reactions specified.

Iron, reddish-black when hot; brown, cold.
Lead, yellow when both hot and cold.
Bismuth, orange when hot; light yellow, cold.
Zinc, yellow when hot; white, cold.

If the assay turns black, organic matter is present, except in the case of copper and cobalt salts.

(e.) No mineral higher than two in the scale of fusibility will fuse in the matrass.

(f.) Most of the metallic sulphides and arsenides give off a gas that precipitates on the cooler part of the tube; this process is called *sublimation.* The metallic sulphides give off a yellow sublimate, and the arsenides a white or a black one. A mixture of both sulphides and arsenides gives off a red, yellow, or, occasionally, a black sublimate.

(g.) Test for gases evolved, as per directions given under Solubility, C. 2. a.

(h.) Note whether the residue has an acid or alkaline reaction; also test with magnet.

(i.) Write down all observations not comprehended in the above directions.

3. Examinations in the open glass tubes. The assay should be placed about three-fourths of an inch from the lower end and angle of the slightly bent tube, which is then inclined and heated B.B. This gives a full draft of air, which is particularly useful in the treatment of certain minerals; some of the sulphides are thus recognized by their giving off sulphurous acid, which would not take place in the closed tube. The odors under this treatment are somewhat different from those given off from the closed glass tube, resembling more those obtained under the blow-pipe on charcoal. Both sublimation and odor should be noticed.

This examination can, ordinarily, be omitted.

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4. *B.B. on charcoal (per se.)* Examine first: (*a.*) In the oxidizing flame—the outer, pure flame; then (*b.*) In the reducing flame—inner flame. Notice

(a.) *Deflagration*, indicates presence of chlorates, nitrates and iodates.

(b.) *Decrepitation.* Quite a number of minerals decrepitate B.B., but the difficulty is obviated by pulverizing the assay in the agate mortar and making a paste with water.

(c.) *Fusion.* Observe according to directions given under Fusibility. If the assay is absorbed, this indicates the presence of some of the alkalies.

(d.) *Odor.* This will be more readily detected upon charcoal than with either the open or closed glass tube.

(e.) *Coating.* Many volatile minerals give characteristic coatings on coal; these should be carefully noted, both near to and distant from the assay.

The reactions in both O.F. and R.F. must also be carefuly studied.

The following examples, taken from Brushes' Determinative Mineralogy, will show the student how to formulate his reactions:

	Near Assay.		*Distant fr. Assay.*	*In O.F.*	*In R.F.*
ARSENIC . .	White.		Grayish.	Volatile.	Volatile with faint blue flame.
ANTIMONY.	White.		Bluish.	Volatile.	Volatile with faint greenish flame.
LEAD	*Hot*	*Cold*	Bluish white.	Volatile.	Volatile with azure blue flame.
	Dark lemon yellow	Sulphur yellow			
ZINC	Yellow	White.		Non-volatile, glows brilliantly. Moistened with co. nitrate and strongly heated becomes yellowish green.	

(f.) The residue should be examined with litmus paper and the magnet.

(g.) Fuse with sodium carbonate.

The assay is generally examined in the R.F. with sodium carbonate. Occasionally it is necessary to pulverize the assay and make it into a paste with water before mixing it with soda. Some minerals that are ordinarily infusible are easily reduced with this flux, forming a glass or slag. Some fuse with effervescence; others remain unchanged, while the soda is absorbed into the coal.

Potassium cyanide is occasionally used as a deoxidizing agent, when the metallic oxide requires a more powerful reducing agent than the sodium carbonate.

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5. Before blow-pipe, with platinum wire and the fluxes. Great care should be used in this examination. The ordinary fluxes are borax, microcosmic salt (salt of phosphorus and ammonia) and carbonate of soda. To examine a mineral with the aid of a flux, a small loop is made at the end of a piece of platinum wire, which is heated red-hot in the flame and then touched to a small amount of the flux to be used; on heating again, a small glassy bead will be gradually formed, and while hot, this is quickly touched to a minute fragment of the mineral to be examined and held in the O.F., the changes being well noted, both while hot and as it cools. The same process should be repeated with the R.F.

A few examples are here given showing reactions with the borax bead:

Iron. In the O.F., it is yellow when hot, nearly colorless upon cooling. In the R.F., dark, bottle green.

Copper. In O.F., green when hot, blue upon cooling. In the R.F., bright red when cold.

Manganese. In O.F., amethystine color. In R.F., colorless.

Similar results will be obtained with microcosmic salt, the color reactions being, however, more delicate; certain minerals may be detected in this that would not be found in borax. The examination with borax is, perhaps, one of the most important tests in blow-pipe analysis. Carbonate of soda is also a valuable flux and should be used in the same manner as the others.

In attempting these examinations, the student should always have at hand, for ready reference, some good work on Blow-pipe Analysis.

6. The Sulphur test. So many minerals contain sulphur that a simple test for it is of great value, especially as this element sometimes escapes detection, even when the assay is heated upon charcoal. The following simple and delicate test is the one commonly employed by all mineralogists:

Some carbonate of soda, chemically pure, is placed in a freshly-made cavity in the charcoal, and, with it, a small fragment of the mineral supposed to contain sulphur. This is fused B.B. and the fused bead is cut out from the charcoal and mashed, with a drop of water, on a bright silver coin; if any sulphur is present, a light yellow or dark spot will be left upon the coin. Sulphur has a stronger affinity for soda than for the mineral that holds it, so sodium sulphide is formed; the silver again has a stronger affiinity for the sulphur than the soda, and therefore silver sulphide is formed.

7. Cobalt nitrate test. Last on the schedule of analysis comes the cobalt nitrate test, which is of value in detecting nearly or quite infusible minerals, such as zinc,

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alumina, magnesia, etc. In using this test, the mineral is first strongly heated in the O.F., then moistened with cobalt nitrate solution and again heated in the O.F.; if it turns light red after cooling, magnesia is present; if blue, alumina or silica; if yellowish green, oxide of zinc is present; dark green, antimony; brownish or brick-red, baryta; if gray, calcium and strontia.

E. **Composition.** After identifying his mineral, the student will find its chemical formula from the Determinative Mineralogy which he uses, and this should be written down under the head Composition on his schedule.

V.—PARAGENESIS, OR ASSOCIATION OF MINERALS.

The student should observe the minerals that are associated with the specimen he is studying. This will not only give variety and zest to his mineralogical excursions, but the knowledge thus obtained will be of considerable value in studying the indications of ores. A few examples of paragenesis are here given:

Galena is almost always associated with either calcite, dolomite, sphalerite or pyrites.

Quartz is often found with feldspar, mica, sphalerite, tourmaline, pyrites, etc.

Pyrites is mostly found with quartz, bituminous coal, galena, fluor, cassiterite.

CHEMICALS AND APPARATUS.

The following is a list of the chemicals and apparatus most needed in blow-pipe analysis, constituting a tolerably complete and inexpensive outfit which every student may and should possess.

Apparatus.—1. *An alcohol lamp,* easily made from an old mucilage bottle with a close-fitting cork, by boring two holes in the cork and inserting two glass tubes, one a little larger and longer than the other; the larger tube is for the wick, which may be made of twine, and the smaller one for a draft of air.

2. *A mouth blow-pipe.* An inexpensive one may be bought at any chemists for from fifty cents upwards. A little ingenuity will enable the student to construct one from a cork, a glass tube and a piece of clay pipe-stem, as follows: bore two holes in the cork, one from the center about half way down and another in the side to meet the first one. Insert a glass tube six or eight inches long in the hole in the center of the cork, and the mouth-piece is ready. File the clay pipe-stem to a conical point at one end and fill the aperture with putty for about an eighth of an inch; then heat it in the flame of an alcohol lamp, and, with a fine needle, bore a minute orifice through

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the putty. Fit the blunt end of the pipe-stem firmly into the side hole in the cork, and a very good substitute for a blow-pipe is obtained.

3. *Platinum forceps.*

4. *A platinum wire* two or three inches long. It is a very good plan to fasten this wire into one end of a glass tube that has been softened in the alcohol flame, as this makes a good handle for the wire and prevents it from being easily lost.

5. *An agate mortar.*

6. *Glass tubing* of soft glass, ¼ lb. assorted sizes.

7. *Test tubes;* one nest will answer.

8. *Small magnet.*

9. *Several watch crystals.*

10. *Charcoal;* well burnt and compact, free from bark.

11. *A hammer.*

12. *Small flat plate of iron.*

13. *Wash-bottle.* Can be made by student.

Dry reagents; all chemically pure.

1. Borax.
2. Microcosmic salt (salt of phosphorus and ammonia).
3. Carbonate of soda.
4. Test papers of litmus and turmeric.
5. Iodide of potassium.
6. Sulphur.
7. Potassium bisulphide.
8. Tin (pure tin foil).
9. Zinc (sheet zinc).
10. Lead (pure).
11. Magnesium wire.
12. Silver coin, freshly polished.
13. Copper oxide.
14. Potassium cyanide.

Wet reagents.

1. Hydrochloric acid.
2. Sulphuric acid.
3. Aqua regia.
4. Cobalt nitrate solution.
5. Barium chloride.
6. Sodium phosphate.
7. Nitric acid.
8. Phosphoric acid.
9. Distilled water.
10. Ammonium hydrate.
11. Silver nitrate.
12. Potassium hydrate.

The following minerals are recommended for the student's use with the schedule, as being particularly adapted to illustrate mineral analysis:

1. Antimony glance.
2. Hematite.
3. Limonite.
4. Magnetite.
5. Apophyllite.
6. Witherite.
7. Strontianite.
8. Cerrusite.
9. Borax.

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10. Salt.
11. Arsenopyrite.
12. Baryte.
13. Magnesite.
14. Calcite.
15. Quartz.
16. Smithsonite.
17. Cinnabar.
18. Orpiment.
19. Molybdenite.
20. Mica.
21. Galena.
22. Cryolite.
23. Talc.
24. Niccolite.
25. Psilomelane.
26. Pyrolusite.
27. Smaltite.
28. Sphalerite.
29. Wolfram.
30. Chalcopyrite.
31. Malachite.
32. Manganite.

The following lists of minerals, in the order given, is a good foundation for a term's work in mineralogy with laboratory practice.

1. Quartz.
2. Calcite.
3. Dolomite.
4. Gypsum.
5. Feldspar.
6. Albite.
7. Labradorite.
8. Serpentine.
9. Talc.
10. Hornblende.
11. Tremolite.
12. Actinolite.
13. Tourmaline.
14. Beryl.
15. Garnet.
16. Epidote.
17. Kyanite.
18. Fluor spar.
19. Graphite.
20. Barite.
21. Magnetite.
22. Hematite.
23. Limonite.
24. Franklinite.
25. Siderite.
26. Pyrite.
27. Sphalerite.
28. Zincite.
29. Smithsonite.
30. Calamine.
31. Galena.
32. Cerrusite.
33. Copper.
34. Chalcopyrite.
35. Malachite.
36. Platinum.
37. Gold.
38. Silver.
39. Rutile.
40. Stannite.
41. Pyrolusite.
42. Psilomelane.
43. Cinnabar.

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The following is a list of the most important works on mineralogy, together with the price of each, when known:

Dana's System of Mineralogy. Last Edition. John Wiley & Son, N. Y.	$10 00
Dana's Text-Book of Mineralogy. John Wiley & Son, N. Y.	5 00
Dana's Manual of Mineralogy and Lithology. John Wiley & Son, N. Y.	2 00
Dana's Old Manual of Mineralogy. Henry H. Peck, New Haven, Ct.	2 00
Brushes' Manual of Determinative Mineralogy. John Wiley & Son, N. Y.	2 50
Bauerman's Systematic Mineralogy. D. Appleton & Co., N. Y.	2 00
Elderhorst's Manual of Qualitative Blow-pipe Analysis and Determinative Mineralogy. Nason & Chandler. Porter & Coates.	1 75
Collins' Mineralogy. 2 Vols. English publication.	
Frazer's Tables for Determination of Minerals.	2 00
Platner's Blow-pipe Analysis, Qualitative and Quantitative.	4 25
Berzelius' Use of Blow-pipe. New York.	1 50
Foyes' Tables for Blow-pipe Analysis of Minerals. Jansen, McClurg & Co., Chicago.	75
Wheeler's Elementary Guide to Determinative Mineralogy. S. J. Wheeler, Chicago.	1 00
C. U. Shepard's Mineralogy. 2 Vols. Out of print.	
Crosby's Guides for Science Teaching, No. 12. Common Minerals and Rocks. Ginn & Heath, Boston.	35
King's U. S. Geological Survey of the 40th Parallel, Vol. III. Mining Industry, with Atlas. Hague.	
New York State Natural History Survey, Part III.—Mineralogy. Peck.	3 00
The various State Geological Survey Reports contain valuable papers on Descriptive Mineralogy and Mining.	
Fuch's Determination of Minerals by the Blow-pipe.	1 25
Alger's Elementary Treatise on Mineralogy. Out of print.	
Ernie's Mineralogy Simplified. Philadelphia.	2 00
Comstock's Mineralogy. Out of print.	
Egleston's Lectures on Mineralogy.	3 00
Manual of Blow-pipe Analysis. H. B. Cornwall.	2 00

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NOTE TO THE STUDENT.

By using a pencil instead of ink in filling out these schedules, mistakes may be more easily corrected. Faber No. 4 is recommended, as it will not blur when rubbed.

The text accompanying the schedules should be thoroughly studied and the work carefully performed, great pains being taken to secure accuracy in the observations and experiments.

ABBREVIATIONS USED IN TEXT AND TABLES.

H_2O, Water.
HCl, Hydrochloric acid.
B.B. Before Blow-pipe.
O.F. Oxidizing flame.
R.F. Reducing flame.
Mic. Salt, Microcosmic salt.

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SYNOPTICAL CHARACTERS.

*Of*_____ _____ *Date,*_____

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. ODOR.

B. TASTE.

C. SOLUBILITY.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B B. in open glass tube.
   (*a*). Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

* Great care should be taken with metals in this case.

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ASSOCIATED MINERALS.

Varieties, with prominent Characteristics_____

Localities _____

Differences _____

Uses in the Arts _____

Uses in Nature_____ _____

Origin in Nature_____

Remarks, Indication of Ores, Etc_____

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A. Odor.

B. Taste.

C. Solubility.
1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
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   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. Distant Assay.
   (*f.*) Residue { Litmus. Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3. can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
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   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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C. SOLUBILITY.

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   (*a.*) Gases evolved?
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1. B.B. Pt. forceps.*
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2. B.B. in closed glass tube.
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   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*g.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

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IV.—CHEMICAL CHARACTERS.

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   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. Distant Assay.
   (*f.*) Residue { Litmus. Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

* Great care should be taken with metals in this case.

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ASSOCIATED MINERALS.

Varieties, with prominent Characteristics_____

Localities _____

Differences _____

Uses in the Arts_____

Uses in Nature_____

Origin in Nature_____

Remarks, Indication of Ores, Etc_____

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SYNOPTICAL CHARACTERS.

*Of*_____ *Date,*_____

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. ODOR.

B. TASTE.

C. SOLUBILITY.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

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IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.
1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. Distant Assay.
   (*f.*) Residue { Litmus. Magnet.
   (*a.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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*Of*_____ *Date,*_____

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IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.
1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B B. in open glass tube.
   (*a*). Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*a.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

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A. Odor.

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1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a*). Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
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IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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A. Odor.

B. Taste.

C. Solubility.
1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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IV.—CHEMICAL CHARACTERS.

A. Odor.

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1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

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1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
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2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
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   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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IV.—CHEMICAL CHARACTERS.

A. ODOR.

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D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
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2. B.B in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. Distant Assay.
   (*f.*) Residue { Litmus. Magnet.
   (*g.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

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   (*d.*) Change color.
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   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*g.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

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   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 8, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

* Great care should be taken with metals in this case.

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ASSOCIATED MINERALS.

Varieties, with prominent Characteristics_____

Localities _____

Differences _____

Uses in the Arts_____

Uses in Nature_____

Origin in Nature_____

Remarks, Indication of Ores, Etc_____

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SYNOPTICAL CHARACTERS.

*Of*_____ *Date,*_____

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.
1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B B. in open glass tube.
   (*a*). Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*g.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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SYNOPTICAL CHARACTERS.

*Of*_____ *Date,*_____

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. ODOR.

B. TASTE.

C. SOLUBILITY.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*g.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

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SYNOPTICAL CHARACTERS.

*Of*_____ *Date,*_____

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.
1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

* Great care should be taken with metals in this case.

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SYNOPTICAL CHARACTERS.

Of— ——— *Date*,———

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.

Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.

(*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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*Of*_____ *Date,*_____

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a*). Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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SYNOPTICAL CHARACTERS.

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I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
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IV.—CHEMICAL CHARACTERS.

A. ODOR.

B. TASTE.

C. SOLUBILITY.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

* Great care should be taken with metals in this case.

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Varieties, with prominent Characteristics_____

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SYNOPTICAL CHARACTERS.

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1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. ODOR.

B. TASTE.

C. SOLUBILITY.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.
2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.
3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.

   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. Distant Assay.
   (*f.*) Residue { Litmus. Magnet.
   (*a.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

* Great care should be taken with metals in this case.

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I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.
1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. ODOR.

B. TASTE.

C. SOLUBILITY.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*g.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

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*Of*_____ *Date,*_____

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. ODOR.

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C. SOLUBILITY.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
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D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
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   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B B. in open glass tube.
   (*a*). Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*a.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

* Great care should be taken with metals in this case.

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ASSOCIATED MINERALS.

Varieties, with prominent Characteristics_____

Localities _____

Differences _____

Uses in the Arts_____

Uses in Nature_____

Origin in Nature_____

Remarks, Indication of Ores, Etc_____

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SYNOPTICAL CHARACTERS.

*Of*_____ *Date,*_____

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.
1. H_2O.
2. HCl.
(*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.
1. B.B. Pt. forceps.*
(*a.*) Fusibility.
(*b.*) Color flame.
(*c.*) Volatility.
2. B.B. in closed glass tube.
(*a.*) Yields H_2O.
(*b.*) Decrepitation.
(*c.*) Glowing.
(*d.*) Change color.
(*e.*) Fusion.
(*f.*) Sublimation.
(*g.*) Gases evolved.
(*h.*) Residue: reaction with Litmus.
" " " Magnet.
3. B.B. in open glass tube.
(*a*). Sublimation.
(*b.*) Odor.
(*c.*) Remarks.
Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.
4. B.B. on Charcoal (*per se*).
(*a.*) O.F.
(*b.*) R.F.
Note—
(*a.*) Deflagration.
(*b.*) Decrepitation.
(*c.*) Fusion.
(*d.*) Odor.
(*e.*) Coating. { Near Assay. / Distant Assay.
(*f.*) Residue { Litmus. / Magnet.
(*c.*) Fuse with Sodium Carbonate.
5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.
7. Cobalt Nitrate.
E. Composition.

* Great care should be taken with metals in this case.

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SYNOPTICAL CHARACTERS.

*Of*_____*Date,*_____

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1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

* Great care should be taken with metals in this case.

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*Of*_____*Date,*_____

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IV.—CHEMICAL CHARACTERS.

A. ODOR.

B. TASTE.

C. SOLUBILITY.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 8, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*g.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

* Great care should be taken with metals in this case.

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*Of*_____ *Date,*_____

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. ODOR.

B. TASTE.

C. SOLUBILITY.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

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I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. ODOR.

B. TASTE.

C. SOLUBILITY.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

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SYNOPTICAL CHARACTERS.

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1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallised. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.
1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*g.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

* Great care should be taken with metals in this case.

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Varieties, with prominent Characteristics_____

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SYNOPTICAL CHARACTERS.

*Of*_____ *Date,*_____

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. ODOR.

B. TASTE.

C. SOLUBILITY.
1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. THERMO-CHEMICAL EXAMINATION.
1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.
2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.
3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.
4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.

   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.
5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.
7. Cobalt Nitrate.

E. COMPOSITION.

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I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

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A. ODOR.

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1. H_2O.
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1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
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2. B.B. in closed glass tube.
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   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

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IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B B. in open glass tube.
   (*a*). Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.
   Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*a.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

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IV.—CHEMICAL CHARACTERS.

A. ODOR.

B. TASTE.

C. SOLUBILITY.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
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   (*e.*) Fusion.
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   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B.B. in open glass tube.
   (*a.*) Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

* Great care should be taken with metals in this case.

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ASSOCIATED MINERALS.

Varieties, with prominent Characteristics_____

Localities _____

Differences _____

Uses in the Arts_____

Uses in Nature_____

Origin in Nature_____

Remarks, Indication of Ores, Etc_____

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SYNOPTICAL CHARACTERS.

*Of*_____ *Date,*_____

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. ODOR.

B. TASTE.

C. SOLUBILITY.
1. H_2O.
2. HCl.
(*a.*) Gases evolved?
3. Other reagents.

D. THERMO-CHEMICAL EXAMINATION.

1. B.B. Pt. forceps.*
(*a.*) Fusibility.
(*b.*) Color flame.
(*c.*) Volatility.

2. B.B. in closed glass tube.
(*a.*) Yields H_2O.
(*b.*) Decrepitation.
(*c.*) Glowing.
(*d.*) Change color.
(*e.*) Fusion.
(*f.*) Sublimation.
(*g.*) Gases evolved.
(*h.*) Residue: reaction with Litmus.
" " " Magnet.

3. B.B. in open glass tube.
(*a*). Sublimation.
(*b.*) Odor.
(*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
(*a.*) O.F.
(*b.*) R.F.
Note—
(*a.*) Deflagration.
(*b.*) Decrepitation.
(*c.*) Fusion.
(*d.*) Odor.
(*e.*) Coating. { Near Assay. / Distant Assay.
(*f.*) Residue { Litmus. / Magnet.
(*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. COMPOSITION.

* Great care should be taken with metals in this case.

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SYNOPTICAL CHARACTERS.

*Of*_____*Date,*_____

I.—PHYSICAL CHARACTERS.	II.—OPTICAL CHARACTERS.	III.—FORM.
1. Touch. 2. Specific Gravity. 3. Structure. 4. Hardness. 5. Fracture. 6. Tenacity. 7. Cleavage { Degree. / Kind. 8. Magnetism. 9. Electricity. 10. Remarks.	1. Color. 2. Lustre. { Kind. / Intensity. 3. Streak. 4. Diaphaneity. 5. Iridescence. 6. Phosphorescence. 7. Remarks.	Condition. 1. Crystallized. 2. Crystalline. 3. Imitative. 4. Amorphous.

IV.—CHEMICAL CHARACTERS.

A. Odor.

B. Taste.

C. Solubility.

1. H_2O.
2. HCl.
   (*a.*) Gases evolved?
3. Other reagents.

D. Thermo-Chemical Examination.

1. B.B. Pt. forceps.*
   (*a.*) Fusibility.
   (*b.*) Color flame.
   (*c.*) Volatility.

2. B.B. in closed glass tube.
   (*a.*) Yields H_2O.
   (*b.*) Decrepitation.
   (*c.*) Glowing.
   (*d.*) Change color.
   (*e.*) Fusion.
   (*f.*) Sublimation.
   (*g.*) Gases evolved.
   (*h.*) Residue: reaction with Litmus.
   " " " Magnet.

3. B B. in open glass tube.
   (*a*). Sublimation.
   (*b.*) Odor.
   (*c.*) Remarks.

Note.—This reaction No. 3, can ordinarily be omitted. See Glossary, IV. D, 3.

4. B.B. on Charcoal (*per se*).
   (*a.*) O.F.
   (*b.*) R.F.
   Note—
   (*a.*) Deflagration.
   (*b.*) Decrepitation.
   (*c.*) Fusion.
   (*d.*) Odor.
   (*e.*) Coating. { Near Assay. / Distant Assay.
   (*f.*) Residue { Litmus. / Magnet.
   (*c.*) Fuse with Sodium Carbonate.

5. B.B. with Pt. wire and Fluxes.

	BORAX.		MIC. SALT.	
	Hot.	*Cold.*	*Hot.*	*Cold.*
(*a.*) O.F.				
(*b.*) R.F.				

6. Sulphur Test.

7. Cobalt Nitrate.

E. Composition.

* Great care should be taken with metals in this case.

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